# Space Weather Technical Forecast

Issued on Tuesday, 17 May 2022 at 13:16 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Chance of R1-R2 radio blackouts.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Moderate over the past 24 hours, with an M2.4 flare at 16/1327 UTC from AR3017 Bxo/Beta in the northeast. There are seven numbered sunspots on the visible disc and one unnumbered region, mainly in the eastern hemisphere. AR3014 Dac/Beta-Gamma is currently the most notable sunspot group, with some subtle growth and magnetic complexity developing, although this is only a modestly sized region. AR3007 Esi/Beta is another region of note, being moderately sized, and also the only one in the southwest, but is now showing signs of simplification. There remain numerous filaments on the disc however no Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind, as measured by ACE and DSCOVR at L1 was elevated, declining from 550 to 500km/s until 17/0400 UTC, but then rising to near 600km/s. The density of the wind was near to slightly above average. The Interplanetary Magnetic Field (IMF) Bt, was Weak to Moderate, ranging between 5nT to 11nT. The north-south component showed fluctuating periods of north/south orientation, between +11 and -8nT, but with more frequent spells of southward field after 17/0200 UTC. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has remained mostly at background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on a current level trend. Observed fluence at 17/0000 UTC was 1.32e6 integrated pfu.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar activity is likely to remain at Low to Moderate levels, with an ongoing chance of M-class flares, and a Slight Chance (5%) of an X-class flare.

**Solar Wind / Geomagnetic Activity:** There are no Earth-directed CMEs. Current elevated solar winds are expected to decline slowly over the next couple of days before the next notable enhancement from the arrival of the fast wind of CH82/+/ This is most likely late day 2 (18th) or early day 3 (19th), although confidence is low. Geomagnetic activity is currently Quiet with isolated Unsettled spells and a slight chance of Active intervals, before then becoming Unsettled to Active with any fast wind arrival, most likely later on day 2 (18th) or early day 3 (19th). Elevated solar winds are then expected to persist day 4 (20th) with Quiet to Unsettled geomagnetic activity.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, albeit with a very slight chance of flux increasing, perhaps above S1, should any notable flares occur, primarily from AR3007. The high energy electron flux (greater than 2 MeV) is forecast to remain at Normal Background to Moderate levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels, mainly by day 4 (20th) due to any fast wind arrival. The 24-

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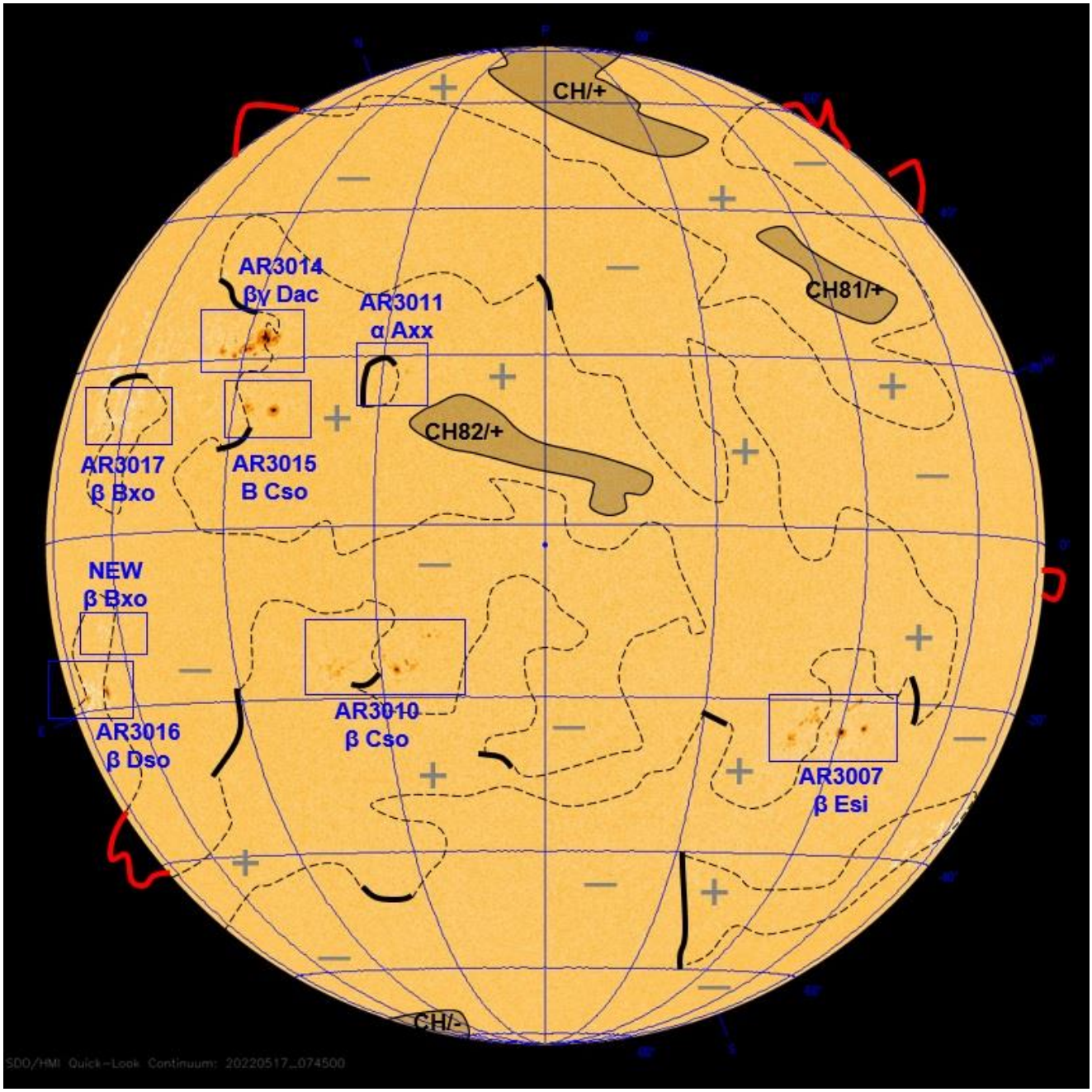
hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period.

**Figure 1. Solar Analysis Valid 17/0800.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

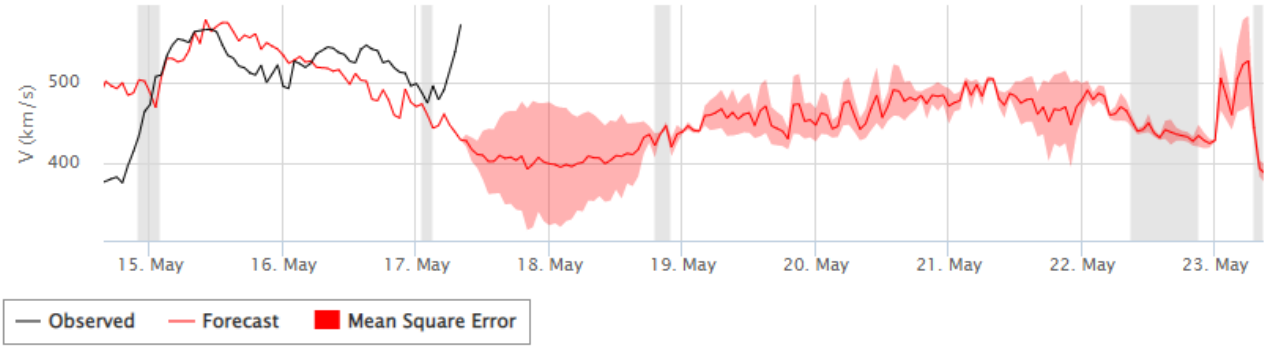
There are no Earth-directed Coronal Mass Ejections (CMEs)

Solar winds are currently Elevated with Earth moving through the fast wind positive polarity CH81. These elevated winds are expected to gradually decline over the next couple of days, prior to the arrival of the fast wind from CH82/+. This is an equatorial hole, and significantly more westward extended than on the previous rotation. Solar wind persistence would suggest a weak arrival on day 3 (19th), whilst enlil is currently indicating arrival either late day 1 or day 2 (17th or 18th). Arrival late 18th or during the 19th is currently favoured, but with low confidence.

Geomagnetic activity is currently Quiet with isolated Unsettled spells. Arrival of fast winds of coronal hole 82 may then increase activity to Unsettled to Active and this is most likely later on day 2 (18th) or early on day 3 (19th).Elevated solar winds are then expected to persist day 4 (20th) with Quiet to Unsettled geomagnetic activity.

| Geo-Magnetic Storm<br>Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 20 | 20 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: Solar Wind Persistence Model**

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## Radio Blackouts - X-Ray Flares:

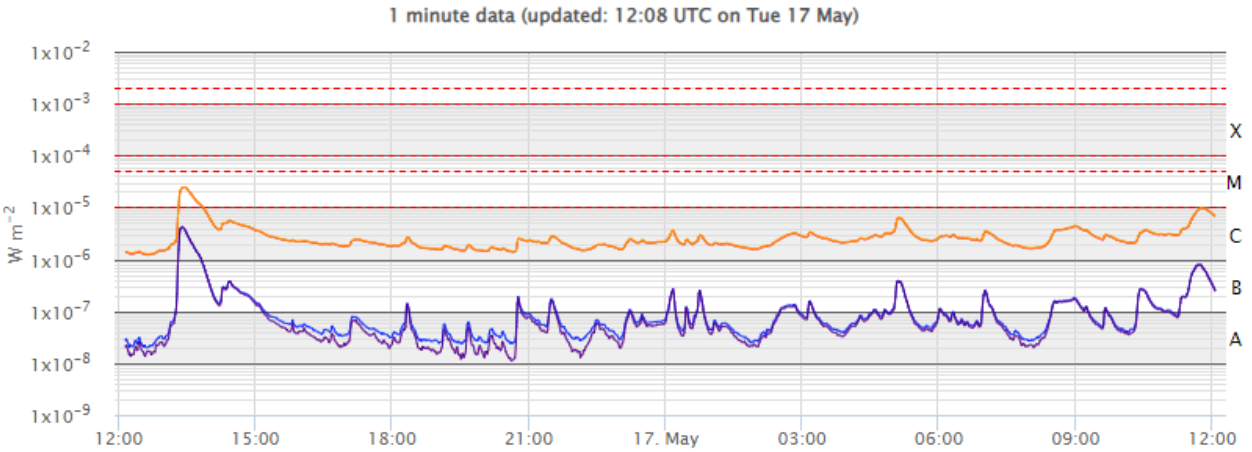
Solar Activity is currently Moderate due to a M2.4 flare from AR3017 Bxo/Beta in the northwest disc. There are seven numbered sunspot regions, and one unnumbered region.

The most notable region is AR3014 Dac/Beta-Gamma, one of a number of spots in the northeast disc. This region has exhibited some growth in the last 24 hours, with some complexity developing to its magnetic structure, increasing the flare risk from this region. AR3007 is the other moderately sized region, and the only one currently located in the southwest, however his has shown signs of simplification through the last 24 hours.

Overall, this gives a chance of further M-class flares (R1-R2 Radio blackouts), with activity expected to be Low to Moderate. There is a very slight chance of an isolated X-class flare (R3 Radio Blackout).

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | Yes | 40 | 40 | 40 | 40 |
| Very Active | R3 to R5 X Class | No | 5 | 5 | 5 | 5 |

**Figure 3: GOES-16/17 X-ray Flux**

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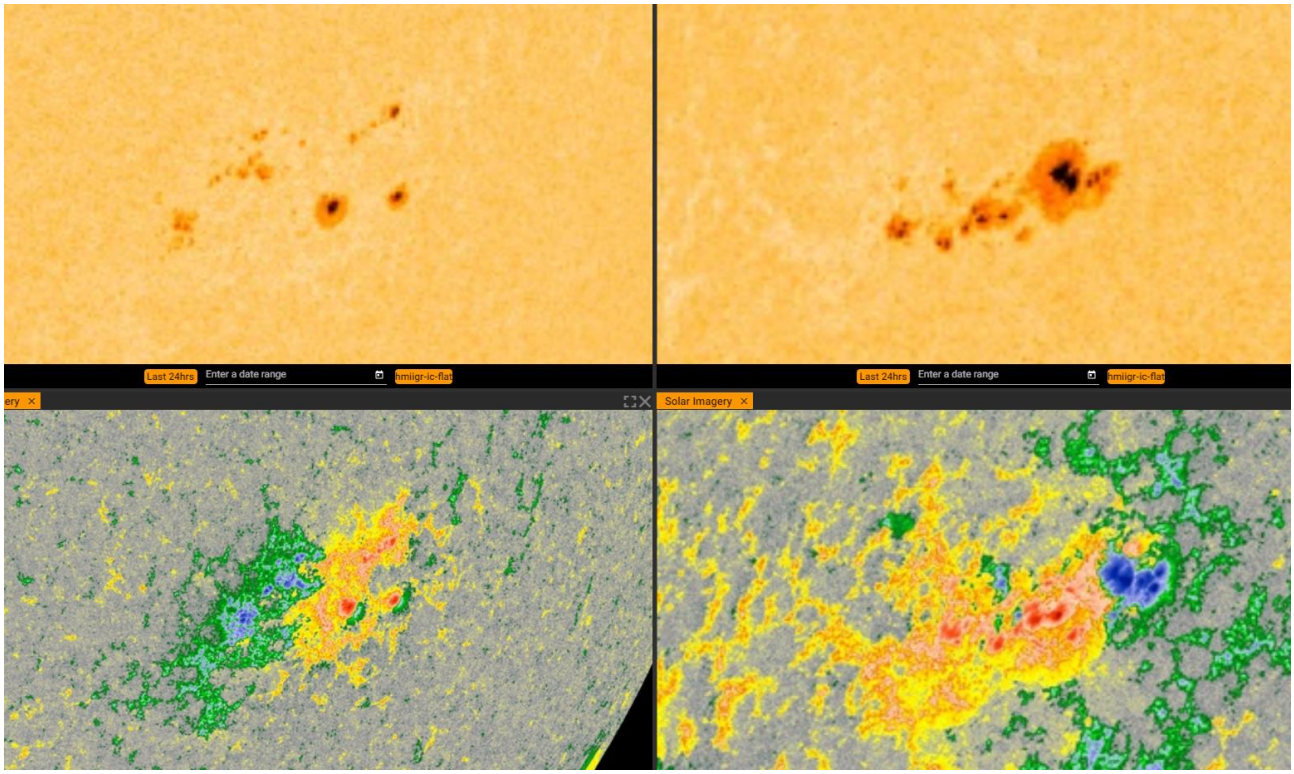
## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at that level throughout the period. However, there is a slight chance of an S1 or greater event during the forecast period, primarily due to AR3007 as it transits westwards towards the western limb of the visible disc.

| Radiation Storms<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 5 | 5 | 5 | 5 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

**Figure 4: SDO Hmi-Intensitygram and Magnetogram showing AR3007 (left) and AR3014 (right)**

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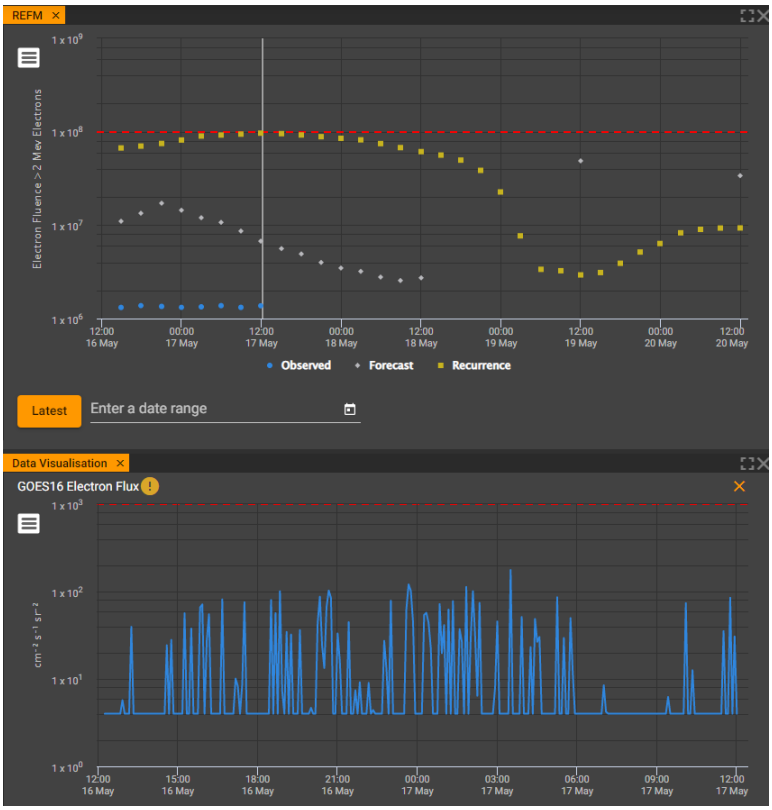
## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO is currently at background levels, but may rise to Moderate levels over the next few days due to fast wind influence from CH81/+ on day 1 and 2 (17th and 18th), followed by further influence from CH82 day 3 (19th) onward. This perhaps giving a chance of flux levels reaching High (1000 pfu) on day 4 (20th)

The corresponding electron fluence is therefore expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output.

| GEO Electron Environment | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 1 | 5 | 5 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 5: GOES-16 >2MeV Fluence with REFM (top) and flux (bottom)**




***NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.***

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